REMARKS

By this Preliminary Amendment, applicants amend originally-filed claims 1-2 to comply with the U.S. Patent and Trademark Office practice and standards. No new matter has been added to the application. Amendments to the claims do not address any issues of patentability, and the amended claims are provided to place the application in better condition for allowance.

Likewise, the amendments to the specification are provided to correct grammatical and syntactical errors in the originally filed application. No new matter has been introduced into the application.

The amendments to the "Claims" are reflected in the attached "Version With Marked Changes Made."

Favorable consideration on the merits is respectfully requested.

Respectfully submitted,

Dated: December 20, 2001

By: _____

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Version With Marked Changes Made

~~In the Claims:~~WE CLAIM:

1. ~~(1)~~ A method for rolling a metal strip ~~(1)~~ in a ~~rolling train, the~~ rolling train having at least two rolling stands, and wherein the metal strip ~~(1) having~~has at least two ~~partial~~ areas ~~(3, 4)~~ of different thicknesses~~, which are~~ connected ~~to one another~~ via a ~~wedge-shaped or approximately~~substantially wedge-shaped transition piece ~~(2)~~, ~~and~~comprising setting the rolling velocity of a rolling stand~~,~~ during ~~the~~ rolling of the ~~wedge-shaped or approximately wedge-shaped~~ transition piece ~~(2), being set~~ as a function of the rolling stand's forward slip ~~of the rolling stand, characterized in that the rolling velocity of a rolling stand during the rolling of the wedge-shaped or approximately wedge-shaped transition piece (2) is also set~~and as a function of the metal strip's temperature ~~of the metal strip (1)~~.

2. ~~A device~~Apparatus for rolling a metal strip ~~(1)~~ in a ~~rolling train, the~~ rolling train having at least two rolling stands, the metal strip ~~(1)~~ having at least two ~~partial~~ areas ~~(3, 4)~~ of different thicknesses~~,~~ which are connected ~~to one another~~ via a ~~wedge-shaped or approximately~~substantially wedge-shaped transition piece ~~(2)~~, ~~and~~comprising means for setting the rolling velocity of a rolling stand~~,~~ during the rolling of the ~~wedge-shaped or approximately wedge-shaped~~ transition piece ~~(2), being set~~ as a function of the rolling stand's forward slip ~~of the rolling stand, characterized in that the rolling velocity of a rolling stand during the rolling of the wedge-shaped or approximately wedge-shaped transition piece (2) is also set~~and as a function of the metal strip's temperature ~~of the metal strip (1)~~.

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TO ALL WHOM IT MAY CONCERN:

Ulrich Lettau, Siegbert Steidl, Wilfried Tautz and Dietrich Wohld, citizens of Germany, residing in Erlangen, Herzogenaurach, Forchheim and Rauschenberg respectively, whose post office addresses are Dummetsweiher 88, 91056 Erlangen, Germany; Schuetzengraben 16D, 91074 Herzogenaurach, Germany; Rotkreuzstr 28 C, 91301 Forchheim, Germany; and Hintere Dorfstr. 3, 91462 Rauschenberg, Germany; respectively, have invented an improvement in:

METHOD AND DEVICE FOR
ROLLING A STRIP OF VARYING THICKNESS

of which the following is a

SPECIFICATION

~~**BACKGROUND OF THE INVENTION**~~

FIELD OF THE INVENTION

[0001] The invention relates to a method and a device for rolling a metal strip in a rolling train, the rolling train having at least two rolling stands, the metal strip having at least two partial areas of different thicknesses, which are connected to one another via a ~~wedge-shaped or approximately~~substantially wedge-shaped transition piece~~, and the~~. The rolling velocity of a rolling stand~~,~~ during the rolling of the ~~wedge-shaped or approximately wedge-shaped~~ transition

piece~~, being~~ is set as a function of the forward slip of the rolling stand, ~~in particular~~particularly in accordance with the German referene DE--A 197 49 424.

BACKGROUND OF THE INVENTION

[0002] Continuous rolling of a metal strip often leads to changes in thickness of more than 20%, which in turn impose high demands on the setting of the rolling train. On account of the temperature of the strip during hot-rolling, there is ~~only~~very little room for ~~maneuver~~maneuvering between looping and necking. This applies all the more if there are changes in thickness of 50% and more. The German reference DE-A 197 49 424 teaches a method for reducing scrap during the hot-rolling of ~~corresponding~~metal strips. It is an object of the invention to further improve the quality of the rolled product in such a procedure ~~of this type~~.

SUMMARY OF THE INVENTION

[0003] According to the present invention~~, the object is achieved by~~ a method ~~in accordance with claim 1 and a device for rolling a metal strip in a rolling train in accordance with claim 2,~~is provided in which~~, to roll~~ a metal strip is rolled in a rolling train~~, the rolling train has at least two rolling stands, the metal strip~~ having at least two rolling stands, and wherein the metal strip has at least two partial areas of different thicknesses~~,~~ which are connected ~~to one another~~ via a ~~wedge-shaped or approximately~~substantially wedge-shaped transition piece~~, and the~~. The rolling velocity of ~~a~~the rolling stand~~,~~ during the rolling of the ~~wedge-shaped or approximately~~substantially wedge-shaped transition piece~~, being~~is set as a function of the forward slip of the rolling stand and the temperature of the metal strip.

BRIEF DESCRIPTION OF THE INVENTION

[0004] ~~Further advantages and details will emerge from the following description of exemplary embodiments. In the drawing:~~The present invention is described in greater detail below in connection with the drawings, in which:

~~FIG. 1 shows~~Figure 1 illustrates a metal strip of variable thickness~~,~~;

~~FIG. 2 shows~~Figure 2 illustrates the curve of set rolling velocities ~~in analogy~~analogous to the method described in DE-A 197 49 ~~424~~,424;

~~FIG. 3 shows~~Figure 3 illustrates addition values for the set rolling velocity~~,~~;

~~FIG. 4 shows~~Figure 4 illustrates set rolling velocity curves taking account of the forward slip of the rolling stand and the temperature of the metal strip~~,~~; and

~~FIG. 5 shows~~Figure 5 illustrates alternative curves for addition values of the set velocity.

DETAILED DESCRIPTION OF THE INVENTION

[0005] ~~FIG.~~Figure 1 shows a metal strip 1 of variable thickness resulting from a changeover of the pass sequence during rolling. When ~~it~~the metal strip 1 exits the final stand of the rolling train, ~~the metal strip 1~~it has an area 4 having ~~the greater~~a thickness~~,~~ which corresponds to the thickness in accordance with ~~the~~an old pass sequence, and an area 3 ~~of~~having ~~lesser~~a thickness~~,~~ which corresponds to the thickness in accordance with the new pass sequence. Area 4 has a greater thickness than area 3. Between the two areas 3 and 4, the metal strip 1 has a wedge-shaped intermediate piece 2. During the changeover of the pass sequence, the reductions and exit thicknesses of all the rolling stands generally change. Therefore, ~~for example~~ according to DE-A 197 49 424, the rolling stands are changed over from the old pass sequence to the new pass sequence at the appropriate time. ~~FIG.~~Figure 2 shows how the set rolling velocity is adapted in

~~analogy to~~ the procedure in accordance with DE-A 197 49 424 for a three-stand rolling train. This figure illustrates the set values for the rolling velocities v plotted against the time t. ~~V11 denotes the~~ The rolling velocity of the first stand~~,~~ is denoted v~~21~~11, ~~denotes~~v21, the rolling velocity of the second rolling stand is denoted v21, and ~~v31 denotes~~ the rolling velocity of the third rolling stand~~.~~ is denoted v31.

[0006] ~~FIG.~~Figure 3 shows an addition value Δv_L for the set rolling velocity as a function of time t. For the sake of clarity, the scale of the velocity is increased compared to ~~FIG.~~Figure 2 and ~~FIG.~~Figure 4. The addition value Δv_L for the set rolling velocity is set in such a manner that the temperature of the strip corresponds as accurately as possible to a desired set temperature. The set velocities are changed by the addition value Δv_L compared to ~~FIG.~~Figure 2. ~~FIG.~~Figure 4 shows the result~~. In this figure~~, wherein v12 denotes the set rolling velocity of the first stand, v22 denotes the set rolling velocity of the second stand, and v32 denotes the set rolling velocity of the third stand.

[0007] In addition to the curve ~~4~~ of the addition value Δv_L shown in ~~FIG. 3, FIG.~~Figure 3 (curve 4), Figure 5 shows further possible curves 5, 6, 7, 8 for the addition value Δv_L. The choice of a suitable curve 4, 5, 6, 7, 8 for the value Δv_L depends on how the desired temperature of the metal strip is to be set ~~in a suitable way~~. Moreover, it is possible to take account of boundary or auxiliary conditions, for example load limits of the roll drives.

[0008] ~~It is particularly advantageous to calculate~~In a preferred embodiment of the present invention, the calculation of a suitable curve 4, 5, 6, 7, 8 for the addition value Δv_L by adaptation, ~~for~~is ~~example~~calculated by means of a neural network.

~~In the Claims:~~WE CLAIM:

1. A method for rolling a metal strip ~~(1)~~ in a ~~rolling train, the~~ rolling train having at least two rolling stands, and wherein the metal strip ~~(1) having~~has at least two ~~partial~~ areas ~~(3, 4)~~ of different thicknesses~~, which are~~ connected ~~to one another~~ via a ~~wedge-shaped or approximately~~substantially wedge-shaped transition piece ~~(2)~~, and comprising setting the rolling velocity of a rolling stand~~,~~ during ~~the~~ rolling of the ~~wedge-shaped or approximately wedge-shaped~~ transition piece ~~(2), being set~~ as a function of the rolling stand's forward slip ~~of the rolling stand, characterized in that the rolling velocity of a rolling stand during the rolling of the wedge-shaped or approximately wedge-shaped transition piece (2) is also set~~and as a function of the metal strip's temperature ~~of the metal strip (1)~~.

2. ~~A device~~Apparatus for rolling a metal strip ~~(1)~~ in a ~~rolling train, the~~ rolling train having at least two rolling stands, the metal strip ~~(1)~~ having at least two ~~partial~~ areas ~~(3, 4)~~ of different thicknesses~~,~~ which are connected ~~to one another~~ via a ~~wedge-shaped or approximately~~substantially wedge-shaped transition piece ~~(2)~~, and comprising means for setting the rolling velocity of a rolling stand~~,~~ during the rolling of the ~~wedge-shaped or approximately wedge-shaped~~ transition piece ~~(2), being set~~ as a function of the rolling stand's forward slip ~~of the rolling stand, characterized in that the rolling velocity of a rolling stand during the rolling of the wedge-shaped or approximately wedge-shaped transition piece (2) is also set~~and as a function of the metal strip's temperature ~~of the metal strip (1)~~.

Abstract

A method and a device for rolling a metal strip (1) in a rolling train, the rolling train having at least two rolling stands, the metal strip (1) having at least two partial areas (3, 4) of different thicknesses, which are connected to one another via a wedge-shaped or approximately wedge-shaped transition piece (2), and the rolling velocity of a rolling stand, during the rolling of the wedge-shaped or approximately wedge-shaped transition piece (2), being set as a function of the forward slip of the rolling stand and of the temperature of the metal strip.

~~FIG. 4~~